

**What Is Claimed Is:**

1           1.    A method of reducing an aspect ratio of a trench,  
2 comprising the steps of:  
3           forming a trench in a substrate;  
4           forming a conformal first insulating layer on a surface of  
5           the trench;  
6           forming a conformal second insulating layer on the first  
7           insulating layer;  
8           forming a conformal third insulating layer on the second  
9           insulating layer;  
10          anisotropically etching the first, second and third  
11          insulating layers to form a remaining first  
12          insulating layer on a sidewall of the trench, a  
13          remaining second insulating layer on the remaining  
14          first insulating layer and a remaining third  
15          insulating layer on the remaining second insulating  
16          layer; and  
17          performing an etching procedure with an etchant to remove  
18          the remaining third insulating layer at a third  
19          etching rate, part of the remaining second insulating  
20          layer at a second etching rate and part of the  
21          remaining first insulating layer at a first etching  
22          rate;  
23          wherein the third etching rate is greater than the second  
24          etching rate and the second etching rate is greater  
25          than the first etching rate.

1           2.     The method according to claim 1, wherein the remaining  
2     first insulating layer, the remaining second insulating layer  
3     and the remaining third insulating layer are lower than a top  
4     surface of the substrate.

1           3.     A method of reducing an aspect ratio of a trench,  
2     comprising the steps of:  
3             forming a trench in a substrate;  
4             using HDP-CVD to form a conformal Si-rich oxide layer on  
5             a surface of the trench;  
6             using HDP-CVD to form a conformal first oxide layer on the  
7             Si-rich oxide layer;  
8             using LP-CVD to form a conformal second oxide layer on the  
9             first oxide layer;  
10            anisotropically etching the Si-rich oxide layer, the first  
11            oxide layer and the second oxide layer to form a  
12            remaining Si-rich oxide layer on a sidewall of the  
13            trench, a remaining first oxide layer on the  
14            remaining Si-rich layer and a remaining second oxide  
15            layer on the remaining first oxide layer; and  
16            performing an etching procedure with an etchant to remove  
17            the remaining second oxide layer at a third etching  
18            rate, part of the remaining first oxide layer at a  
19            second etching rate and part of the remaining Si-rich  
20            oxide layer at a first etching rate;  
21            wherein the third etching rate is greater than the second  
22            etching rate and the second etching rate is greater  
23            than the first etching rate.

1           4.     The method according to claim 3, wherein the remaining  
2     Si-rich oxide layer, the remaining first oxide layer and the  
3     remaining second oxide layer are lower than a top surface of the  
4     substrate.

1           5.     The method according to claim 3, wherein the formation  
2     of the trench comprises the steps of:  
3             forming a shield layer on part of the substrate; and  
4             using the shield layer as a mask, etching part of the  
5             substrate to define the trench therein.

1           6.     The method according to claim 5, wherein the shield  
2     layer comprises a pad oxide layer and a silicon nitride layer.

1           7.     The method according to claim 3, further comprising,  
2     before forming the Si-rich layer, a step of:  
3             forming a conformal linear layer on the surface of the  
4             trench.

1           8.     The method according to claim 3, wherein the first  
2     oxide layer is a SiO<sub>2</sub> layer formed by HDP-CVD.

1           9.     The method according to claim 3, wherein the second  
2     oxide layer is a TEOS-SiO<sub>2</sub> layer formed by LP-CVD.

1           10.    The method according to claim 3, wherein the etchant  
2     is a BOE solution.

1           11.    The method according to claim 10, wherein the third  
2     etching rate is 800Å/min, the second etching rate is 400Å/min  
3     and the first etching rate is 200Å/min.

1        12. The method according to claim 3, wherein a thickness  
2 of the Si-rich layer is 50~100Å, a thickness of the first oxide  
3 layer is 100~120Å and a thickness of the second oxide layer is  
4 100~150Å.

1        13. A method of reducing an aspect ratio of a trench,  
2 comprising the steps of:  
3        forming a trench in a Si substrate;  
4        using HDP-CVD, forming a conformal Si-rich oxide layer on  
5        a surface of the trench, wherein a thickness of the  
6        Si-rich layer is 50~100Å;  
7        using HDP-CVD, forming a conformal first silicon oxide  
8        layer on the Si-rich oxide layer, wherein a thickness  
9        of the first oxide layer is 100~120Å;  
10       using LP-CVD, forming a conformal second silicon oxide  
11       layer on the first silicon oxide layer, wherein a  
12       thickness of the second oxide layer is 100~150Å;  
13       anisotropically etching the Si-rich oxide layer, the first  
14       silicon oxide layer and the second silicon oxide  
15       layer to form a remaining Si-rich oxide layer on a  
16       sidewall of the trench, a remaining first silicon  
17       oxide layer on the remaining Si-rich layer and a  
18       remaining second silicon oxide layer on the remaining  
19       first silicon oxide layer; and  
20       performing an etching procedure with a BOE solution to  
21       remove the remaining second silicon oxide layer at  
22       a third etching rate, part of the remaining first  
23       silicon oxide layer at a second etching rate and part

24           of the remaining Si-rich oxide layer at a first  
25           etching rate;  
26       wherein the third etching rate is greater than the second  
27           etching rate and the second etching rate is greater  
28           than the first etching rate.

1       14. The method according to claim 13, wherein the  
2       remaining Si-rich oxide layer, the remaining first silicon oxide  
3       layer and the remaining second silicon oxide layer are lower than  
4       a top surface of the silicon substrate.

1       15. The method according to claim 13, wherein the  
2       formation of the trench comprises the steps of:  
3       forming a shield layer on part of the silicon substrate;  
4       and  
5       using the shield layer as a mask, etching part of the  
6       silicon substrate to define the trench therein.

1       16. The method according to claim 15, wherein the shield  
2       layer comprises a pad oxide layer and a silicon nitride layer.

1       17. The method according to claim 13, further comprising,  
2       before forming the Si-rich layer, a step of:  
3       forming a conformal linear layer on the surface of the  
4       trench.

1       18. The method according to claim 13, wherein the first  
2       silicon oxide layer is a SiO<sub>2</sub> layer formed by HDP-CVD.

1       19. The method according to claim 13, wherein the second  
2       silicon oxide layer is a TEOS-SiO<sub>2</sub> layer formed by LP-CVD.

Client's ref.: NTC-91198/吳昌榮等  
File: 0548-9346usf/Jacky/Steve

1           20. The method according to claim 13, wherein the third  
2 etching rate is 800Å/min, the second etching rate is 400Å/min  
3 and the first etching rate is 200Å/min.